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[The evolution of R Hya] The evolution of the Mira variable R Hydrae [A.A. Zijlstra et al.]

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abstract

The Mira variable R Hydrae is well known for its declining period, which Wood & Zarro (1981) attributed to a possible recent thermal pulse. Here we investigate the long-term period evolution, covering 340 years, going back to its discovery in AD 1662. The data includes photometric monitoring by amateur and other astronomers over the last century, and recorded dates of maximum for earlier times. Wavelets are used to determine both the period and semi-amplitude. We show that the period decreased linearly between 1770 and 1950; since 1950 the period has stabilized at 385 days. The semi-amplitude is shown to closely follow the period evolution. Analysis of the oldest data shows that before 1770 the period was about 495 days. We find no evidence for an increasing period during this time as found by Wood & Zarro. We discuss the mass-loss history of R Hya: the IRAS data shows that the mass loss dropped dramatically around AD 1750. The evolution of the mass loss as function of period agrees with the mass-loss formalism from Vassiliadis & Wood; it is much larger than predicted by the Blöcker law. An outer detached IRAS shell suggests that R Hya has experienced mass-loss interruptions before. The period evolution can be explained by two models: a thermal pulse occuring around AD 1600, or an non-linear instability leading to an internal relaxation of the stellar structure. The elapsed time between the mass-loss decline giving rise to the outer detached shell, and the recent event, of approximately 5000 $yrsuggeststhatonlyoneoftheseeventscouldbeduetoathermalpulse.Furthermonitoringof RHyaisrecommended, asboth$ $typeeventscouldprovidepartoftheexplanationfortheringsseenaroundsomeAGBandpost-AGBstars.ChangesinMiraprope$ $to-cyclebasis, andonthethermal-pulsetimescaleof\sim 10^4$ yr. R Hya shows that significant evolution can also occur on intermediate time scales of order 10^2–10^3 yr.